solplan review

the independent newsletter of energy efficient building practice

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INSIDE..

Exterior moisture penetration into the building fabric is of concern but it is not necessary to suffer the problem as the solution is simple if basic building science tenets are followed. We review the features of the Rain screen principle.

Heating system efficiency is always of interest. Manufacturers make claims for efficiency, but all parts in the system impact on the performance. In mild climates good equipment too often is devalued by unsuitable installations such as ducts located outside the heated envelope. We report on a study that looked at this.

Airtight Drywall approach construction has become a popular way to build tight building envelopes. We review monitoring work on early ADA houses built in Edmonton.

Urea formaldehyde is a major indoor pollutant. We review work done on indoor air quality, ventilation rates and what kind of correlation may exist.

Other items include a commentary on the legal implications of ventilation system design and installation, thoughts on airtightness testing procedures, insulation prices across Canada (comparing their cost per R-value), news of a new structural lumber product, a new insulation product, and a description of a new chimney cap that eliminates problems of downdrafts.

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THE RAIN SCREEN PRINCIPLE

FROM THE PUBLISHER

A proposed Free Trade agreement between Canada and the USA has been signed. The sales job is now being mounted to convince us that it is a good deal. We have noticed that one of the examples being used is that the average home price should be reduced as a result of the reduction of tarifs. Sounds good, right?

As in all such deals, there are good and bad points. To date we have have not been given an honest assessment of both sides of the deal.

Why be concerned? Economic decisions are affected by the psychology of the market place. If people feel good about about themselves, they will carry-on as usual. If they feel uncertain, they stop spending and a recession takes hold. At first, most people are going to be possitive about the free-trade deal, but when the adjustements to the economy set in (and they will) so will uncertainty and an economic slowdown. We have no real idea of what the long term implications are going to be.

It's fine to say that it will be cheaper to build a house, but if people can't afford to buy it because their income has dropped (or their assets have lost value), who's going to buy the cheaper house?

The concern about the deal is not so much with the idea of free trade, but the far reaching nature of the specific deal. Just because we want a deal does not mean we have accept the deal being proposed if it is not satisfactory in all respects. We must remember that legal agreements become binding, based on the treaty language, and not on the good will and intent of the parties to it.

When was the last time you got $50,000 even through the contract stated $40,000?

Richard Kadulski
Publisher

HRV RATINGS: vanEE 1000

The R-2000 Program has required that ventilation systems be rated at a capacity of 55 l/s (110 cfm) at 100 Pascals pressure. For this reason, ORF testing was only done at the higher flows.

However, with all housing now requiring mechanical ventilation, of which heat recovery provides one option, manufacturers have responded with new smaller HRV units. There are especially suited to small homes and multiple units.

The R-2000 Program is now accepting smaller HRV units tested at airflows of 30 l/s (60 cfm) instead of 55 l/s. ORF now has the facility, and has begun the testing of the smaller units. The first of the units tested is the vanEE 1000 series.

vanEE 1000

ORF test results for this unit shows a **net supply airflow (75 Pa)** of 129 cfm.

At 0°C, net airflow of 64 cfm, power consumption of 69 watts, and an efficiency of 67%.

At -25°C, net airflow of 64 cfm, power consumption of 69 watts, and an efficiency of 58%.

vari-QUIET™

VanEE has announced a modification to available speed controls: an "inexpensive option" that provides adjustable, continuous ventilation without the humming noise usually associated with standard speed controls. This is available on the 1000 and 2000 series VanEE heat recovery ventilators.

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THE RAIN SCREEN

The durability of wood frame walls in damp climates has been a concern for a long time. The concern arises from stories of warped siding and rotting framing. Many of these problems have been identified in our housing stock, leading to increased housing costs and contributing to the resistance to the use of wood products abroad. Thus it is important not only for our housing stock but also to the economy in general to design structures that overcome moisture related problems.

In recent years houses have become tighter, insulation levels have been improved and flueless heating become more common. The incidence of moisture in walls has also increased. Surveys have indicated a concentration of moisture problems in coastal areas especially in Atlantic Canada.

There are two main sources of moisture in exterior walls. One is the outward migration of moist warm air from the house. Under the right conditions this moisture will condense against the exterior surfaces. The other is exterior bulk moisture (rain, snow, sleet) which in the right conditions can penetrate into the wall.

Solar radiation and wind are the main forces drying the wall. The use of furring (or strapping) under siding improves the drying ability of the wall.

Strange suggestions have been made for dealing with the problem of moisture in the walls. One that has been proposed is vents to act as chimneys that would lower the internal pressure in the building by stack effect, thus preventing the outward migration of humid air. There are many reasons why this kind of approach is not the desireable way to deal with the potential problem.

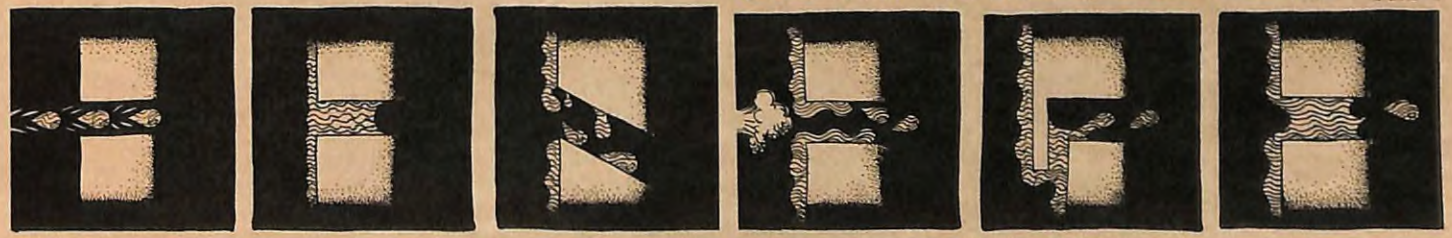
The performance of a building envelope, unlike that of a manufactured product is not simple to determine. The wall is built of many materials and components. However, due to the nature of many of these materials (i.e. wood, fibre or particles) their performance thermally and under vapour pressure varies over an astonishing range. There is a lack of understanding of the problem both in the construction industry and in the scientific community.

Most research on moisture problems has focused on the question of how moisture moves outward from the inside of the house, through the wall and at what point within the wall it condenses. There are many simple steady state theoretical models of this process but they do not account for other factors such as air leakage, variations in the weather, solar incidence, rain or mist penetration. Whether or how much moisture damage will actually occur depends on all these factors.

Rain penetration results from a combination of water on a wall, openings to permit its passage and forces to drive or draw it inward. By avoiding these conditions, it can be prevented.

There are many openings that allow the passage of water in the form of pores, cracks and joints between materials. Even when water is available and an opening exists, leakage will not occur unless a force is present to move the water through the opening. The forces contributing to rain penetration are kinetic energy of the rain drop, capillary suction, gravity and air pressure differences.

Wind can drive rain drops against a wall with considerable velocity so that their momentum or kinetic energy carries them through large openings. If an opening is small, the rain drop will be shattered upon impact, but small droplets will continue inward. If there is no through path, water cannot pass deeply into the wall. Battens, splines, baffles, or interlocks can be used to advantage at joints to control rain penetration induced by kinetic energy.

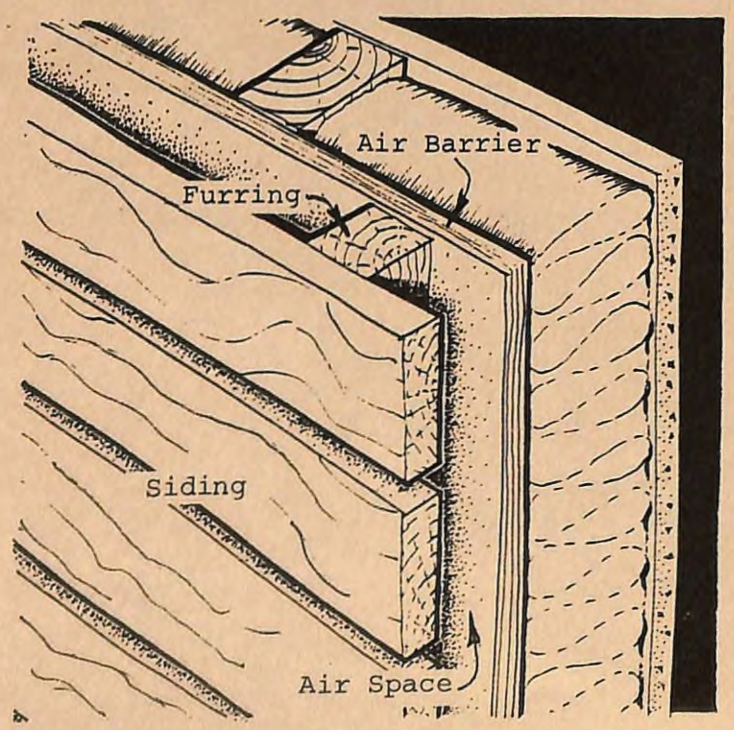


Kinetic energy | Capilarity | Gravity | Air Currents | Wind Pressure & Capilarity | Wind Pressure

Capillary suction only draws or holds water in a space bound by wettable surface. When a material approaches saturation the capillary suction approaches zero, but the water it holds will have no tendency to ooze out from it unless an external force is introduced. Fine capillaries (less than 0.01 millimetre) draw and hold small quantities of water with such high suction that they seldom contribute to rain penetration.

Partial moisture penetration of a wall by capillarity is difficult to overcome, but total penetration can be controlled by introducing a discontinuous air gap in the capillary, the joint, or the wall. An air space or discontinuity in the joint or wall immediately behind the wetted face will prevent additional flow of water inward. Water reaching this space will cling to the surface and will flow down the outer face of the space so that it will be led out of the wall by flashings at suitable locations.

As with capillary suction and gravity, water entry resulting from a pressure difference can be controlled by the introduction of an air space in the joint or wall. However, the air pressure in the space must always be equal that on the wall face. This can be accomplished by providing enough free open area to the exterior to allow the wind to maintain an equal pressure on both sides of the cladding.



When the air pressure both outside and inside a wetted plane are equal, there is no pressure difference to drive the water inward.

Through-the-wall penetration of rain can be prevented by incorporating an air chamber into the joint or wall where the air pressure is always equal to that on the outside. The outer layer becomes an open "rain screen" that prevents wetting of the actual wall or air barrier of the building. It is important to remember that the air barrier of the building must be located inside of this air space.

The rain screen principle for controlling moisture penetration can be used any place where rain penetration of walls can occur, especially at joints between components.

An important consideration in the application of the rain screen principle is that air pressures on the exterior of a building vary across the building face, depending on whether it is windward of leeward side of the building. As these pressures could move a large amount of water or snow into the space, with the risk of rain penetration, the air space should be interrupted at suitable intervals. A compartmentalized space minimizes lateral air movement.

A good rain screen will ensure that the structure will not be wetted by exterior weather borne moisture. A properly built shake or tile roof is nothing more than a rain screen - keeping out the bulk moisture brought down by storms. The same principles should be followed to build durable walls.

HEATING SYSTEM PERFORMANCE

To compare annual energy costs of various space heating systems, it is necessary to know the seasonal efficiency by which each system converts input energy (gas, oil, electricity, wood) into useful heat.

It is not always easy to determine the real seasonal efficiency of a complete heating system, especially in the case of forced air heating systems. Laboratory or field testing of the total heating system (furnace, air distribution, controls) is complicated because of the many variables that affect performance over a complete heating season.

A study by George Tsongas at Portland State University in Oregon set out to determine the seasonal efficiency of gas and electric space heating systems, to compare their annual heating costs. The study looked at typical installations found in the Portland area. These commonly have the furnace in the garage, uninsulated ductwork in the (unheated) crawl space, and insulated foundation walls (but no insulation between floor joists).

The efficiencies commonly used by the furnace industry are those defined in the ASHRAE 1983 Equipment Handbook. They include:

1) steady-state efficiency
2) utilization efficiency
3) annual fuel utilization efficiency AFUE
4) seasonal efficiency

Each is a measure of the performance of the furnace alone.

STEADY-STATE EFFICIENCY

This is the efficiency of a furnace alone when it is operated under steady-state or equilibrium conditions after a full warmup period (usually 15-30 minutes). It accounts for energy that is lost up the flue, but other losses such as cycling during furnace warmup and shutdown are not included. It is calculated by measuring the energy input, subtracting the losses for exhaust gases, and then dividing by the input.

Older, conventional gas furnaces typically have values in the range of 75-80%. Some of the new, high efficiency condensing gas furnaces can have values over 90%. But as most furnaces seldom operate under steady-state conditions, the steady-state efficiency is not a good indicator of relative performance.

UTILIZATION EFFICIENCY

This method starts with 100% efficiency for a furnace and deducts losses determined by analytic modeling for stack flow, cycling, infiltration, and pilot burner effects. Because more losses are considered, the utilization efficiency is generally lower than the steady-state efficiency.

ANNUAL FUEL UTILIZATION EFFICIENCY (AFUE)

AFUE is calculated in the same manner as the utilization efficiency with an additional term deducted from the output for pilot light energy use during the non-heating season.

The AFUE value is like the EPA automobile mileage figure. It attempts to represent an estimate of the annual performance of a furnace alone based on average usage conditions and average weather conditions.

However, it does not include an estimate of the effect on performance of other heating system components such as the air distribution or the controls.

SEASONAL EFFICIENCY

This is an efficiency used by the State of California. It is roughly three percentage points less than the AFUE for the identical unit because it accounts for the electrical energy input used for fan motors.

THE TOTAL SYSTEM

Describing the seasonal or annual performance of a complete forced warm air space heating system is much more complicated than describing the performance of a furnace alone.

The various factors that influence the overall performance of heating system include:

1) Furnace efficiency
2) Duct efficiency (**duct losses of 35-45% are common**).
3) Miscellaneous gain factor. This accounts for unintentional but beneficial, heat that reaches the conditioned space from components like the ducts.
4) Load modification factor. This accounts for the influence on the system's overall efficiency of the equipment's operational effect on the building heat load. Heat losses to intermediate spaces, like the

basement or crawl space, that somehow end up in the conditioned space (either by positive heat flow or by reduced heat loss) are included in the load Modification Factor.

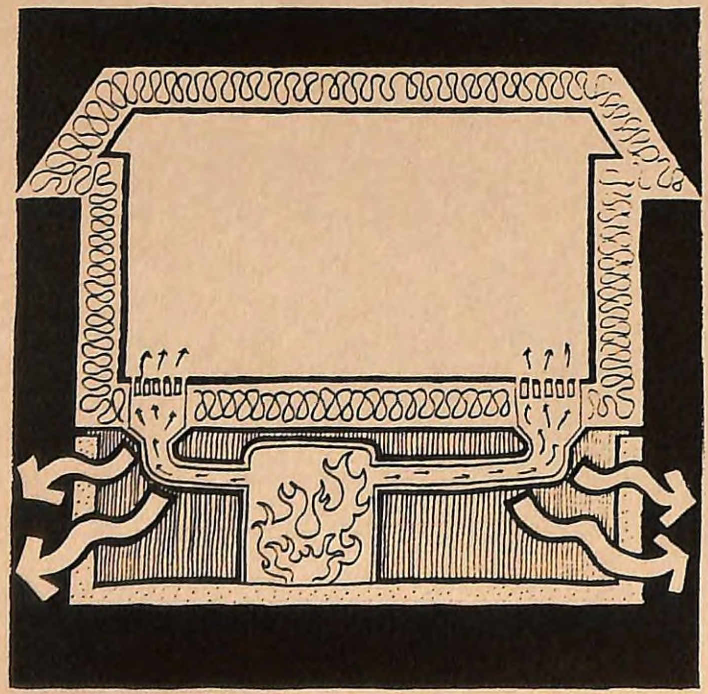
5) Energy Cost Factor.

According to studies for each 20% of oversizing the furnace efficiency should drop about 1-2%.

Generally speaking, it is not a widely recognized fact that the most inefficient part of a forced air heating system can be the air distribution system (unless the ducts are inside the heated space). This may not come as a surprise to people living in cold climate areas, but it is amazing how often ductwork is located outside the heated envelope.

In furnace sizing, a standard rule of thumb has been to increase the size by 10 or 15% if the ducts are outside the heated space. However, there seems to be no recognized basis for such a rule of thumb. It may never have been a problem because furnaces have normally been grossly oversized.

Results using ASHRAE simulation models indicated that the real seasonal delivery efficiency of natural gas forced air systems ranges from a low of 17% in the worst case to about 60% for the most efficient condensing gas furnaces (with laboratory generated AFUE values of 95% or greater).



In other words, half the energy input to the furnace is lost and never reaches the heated living space. The major cause for the poor performance efficiencies is losses from ductwork located outside the heated space. Duct heat losses of 40% are common for all types of forced air systems. The duct losses could be largely eliminated by installing the ductwork **inside** the heated envelope.

Ducts have a large surface area from which to lose heat. The air temperature inside the duct usually ranges from that of the living space to that of the hot air at the furnace heat exchanger (which can be as high as 150-160°F). However, at best ducts are insulated with R2-4 insulation, even though floors may insulated with R-20 or more.

In addition to the heat loss through the duct wall there is an energy loss due to air leakage. In the case of uninsulated ducts in an unheated basement increasing the duct leakage from 0% to 20% reduces the duct efficiency by about 8%. This assumes that all the air that leaks out of the supply ducts is balanced by the same amount of air leakage into the return air ducts.

It is extremely hard to prevent ducts from leaking. Joints are hard to seal, conventional duct tape becomes loose with time and temperature fluctuation, and there are numerous opportunities for leakage that are seldom considered.

Thus, even the best forced air furnace is surprisingly inefficient overall when the complete system is considered. Usually only the furnace efficiency is considered, and that can be misleading.

This study was prepared for Portland General Electric. One can assume it provides the electric utility with ammunition for marketing electric space heating in competition against natural gas. But the results also show that a poorly laid out gas fired forced air heating system would not be more expensive to operate than a baseboard type electric heating system.

ADA PERFORMANCE

Air leakage is most commonly managed using caulked polyethylene. However, this air barrier system is easily damaged and, once covered with drywall, can neither be inspected nor repaired. Strict supervision is essential to ensure that the polyethylene air barrier is installed properly and not damaged. An alternative method that has been developed in recent years in the air tight drywall approach (ADA).

The airtight drywall approach to house construction has attracted considerable interest. In B.C. a significant portion of new homes built use a variation of this construction type. However, there are still nagging doubts and concerns about the long term performance of houses built using ADA. A recently completed monitoring study by Howell-Mayhew Engineering Inc. in Edmonton begins to answer some of these concerns.

The objective of the study was to assess ADA as implemented in three test houses and to compare the performance of these houses against three typical houses in Edmonton.

The study focused on four aspects of house performance: integrity of the air barrier system; energy conservation measures; performance of the ventilation systems; and indoor air quality.

Data was gathered to record the change in air-leakage characteristics over a one year period, measure the energy used, record the factors which significantly affected the energy used, record the performance of the heating and ventilation systems and measure typical indoor air quality parameters.

Air Barrier System

The results of the air leakage tests indicated that ADA was an effective method of reducing air infiltration in homes. Infiltration in the ADA homes originally ranged from 0.52 to 1.13 air changes per hour (ac/h) at 50 Pa. After 1 year, the air leakage tests showed some deterioration in air tightness. (The tests ranged from 0.671 to 1.80 ac/h at 50 Pa). Air leakage in the conventional homes ranged from 2.23 to 2.59 ac/h at 50 Pa with very little change over 1 year.

The floor joist sealing technique used in the ADA houses was observed to deteriorate significantly within a year. The major problem areas were caulking at rim joist. In one house the dry wall had been fitted between the joists and then caulked to them. The caulking deteriorated and the air barrier was no longer continuous. As the basement was not finished these areas could be recaulked if desired. A longer term assessment of the air barrier integrity of ADA houses is needed to confirm the durability of the components used for air sealing. The multi-year monitoring project of Flair Homes in Winnipeg currently underway should provide more information.

Energy Conservation Measures

The monitoring results showed a significant reduction in energy consumption in the homes with energy conservation features. The data shows that for an average Edmonton winter, a 140 m^2 (1500 sq. ft.) home incorporating the energy conservation features in the ADA test houses would require 23% - 32% less heat than a conventionally built home using 2x6 walls and R-20 insulation.

It follows that savings on natural gas costs should be similar. However, since actual heating costs are highly dependent on internal gains and occupant lifestyle, a general prediction of precise savings with any energy conservation strategy including ADA is difficult to make.

Indoor Air Quality

Measurements of air-borne contaminants indicated that the reduction of air infiltration using ADA techniques (which includes mechanical ventilation) did not decrease the quality of the indoor air.

The homes performed similar to other energy-efficient homes monitored across Canada and pollutant levels were below accepted guidelines. However, due the small number of measurements, the results cannot be regarded as scientifically conclusive.

However, a couple of interesting observations were made. Formaldehyde levels were within acceptable levels but in 2 of the ADA houses they increased after the second year. In one house this happened because the HRV motor became noisy, so homeowners were turning the unit off at night. In another, high levels were noted in the bedrooms suggesting that air distribution was not happening evenly, and more air was needed in the bedrooms. The homeowner was not using the ventilation system because the controls were located out of reach in the basement joist space, making operation inconvenient.

Information Transfer

Interviews with homeowners revealed that they did not have a clear understanding of the function of ventilation systems, nor how to clean filters, use speed controls, or set dehumidistats. This lack of knowledge offsets the performance of the Ventilators and their useful service. Better transfer of information from the builder to the homeowner is essential if the homeowner is to understand how to operate and maintain the heating and ventilation systems in their houses.

Energy Performance of Three Airtight Drywall Approach Houses

Howell Mayhew Engineering Inc. For:
Alberta Municipal Affairs
Innovative Housing Grants Program.
9925-107 Street
Edmonton ALTA T5K-2H9

FORMALDEHYDE & INDOOR AIR QUALITY

When indoor air quality is discussed, formaldehyde is the key pollutant that is usually considered.

Formaldehyde is a potent eye, upper respiratory tract and skin irritant. Some studies also indicate that it is a central nervous system depressant. It can cause asthma and induce asthmatic attacks.

Low-level formaldehyde exposures commonly found in homes are enough to worsen a variety of existing symptoms or cause them directly. In homes where formaldehyde contamination is noted, it appears to be associated with low-level sources such as furniture and paneling. Measured formaldehyde levels are in the range of 0.02 to 0.07 ppm with peak levels typically 0.05 to 0.06 ppm.

Studies at Ball State University in Indiana have established the following relationships between symptoms and formaldehyde concentrations: at an average level of 0.11 ppm: runny nose, sore throat, sleep difficulty, headache, fatigue, difficult breathing, sinus irritation, eye irritation, chest pain and menstrual problems set in. The threshold level where reactions appear is about 0.05-0.06 ppm.

One of the most notable symptoms associated with residential formaldehyde exposures is menstrual irregularities or disorders. Such irregularities have been reported in 3 different studies in 3 different countries. The relationship between menstrual irregularities and formaldehyde exposure, particularly in the residential environment, has received little attention by health practitioners. Absence from a higher formaldehyde level environment for a month or more should provide an indication whether the menstrual disorder is associated with formaldehyde exposure.

Although formaldehyde is used in a large variety of consumer products, some release quantities of free formaldehyde in enough quantity to significantly contaminate indoor air. Problem products use urea-formaldehyde resins in their manufacture. These include particleboard subflooring, paneling, cabinetry, furniture, and hardwood plywood paneling. For wood products these resins are used interior-grade adhesives.

Formaldehyde and Ventilation

A National Research Council of Canada study measured indoor formaldehyde levels and ventilation rates for sixteen similar houses and used a simple model to relate these two items. The houses were one to two years old wood frame bungalows with full depth cast in place concrete basements.

The net source strengths calculated suggested that in these houses the major interior source of formaldehyde were the building components themselves.

Conventional homes with particleboard subflooring (2-5 years after installation) have measured levels of formaldehyde in the range of 0.06 to 0.30 ppm with peak levels in the range of 0.20 to 0.30 ppm. With low emission particleboard materials which are becoming available in the USA, peak formaldehyde levels associated with a newly applied subfloor can be expected in the range of 0.10 to 0.15ppm. Kitchen and bathroom cabinets alone have the potential for causing residential formaldehyde to rise to levels of 0.10ppm or higher, specially when they are new.

The mobile home, however, exposes its residents to the highest formaldehyde levels. Formaldehyde levels in mobile homes have been measured in the range of 0.20 - 0.50 ppm with values as high as 1-2 ppm reported for mobile homes manufactured before 1980.

The indoor relative humidity was not well related to the ventilation rate. Thus the study questions the effectiveness of controlling ventilation by an indoor dehumidistat.

Bedroom formaldehyde levels were significantly higher than the living room levels, suggesting that design of the air distribution system must be given careful consideration.

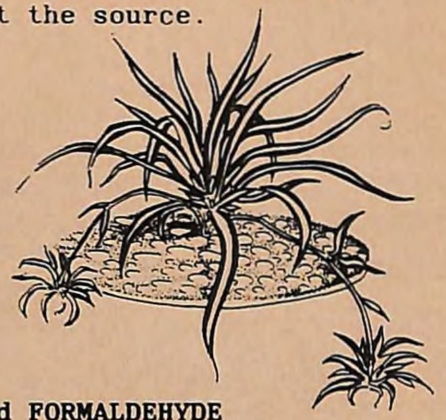
The relationship between temperature, humidity and the formaldehyde release rate from building materials is complex and not well understood at the present time. However, increasing the temperature or relative humidity will increase the steady-state formaldehyde concentration for a given air flow. Results show that increasing the indoor air temperature from 20°C to 23°C will increase the formaldehyde concentration by about 15%. Increasing the indoor relative humidity from 40% to 50% causes an increase in formaldehyde concentration of about 35%.

The National Research Council Study suggested that in general, humidity does not appear to be a good indicator or basis for control of indoor air quality control. It also found that the natural ventilation rate was inadequate for indoor air quality control. A minimum air change rate of approximately 0.3 ach would be required to maintain acceptable levels of indoor formaldehyde.

In houses without forced air heating systems, the air exchange system must circulate air through the entire house to prevent localized areas from having low ventilation and high pollutant concentrations.

The choice of building components that do not emit formaldehyde (reducing the source strength) can reduce the amount of ventilation required to control this pollutant. Since other indoor air pollutants may also be present, reduction of formaldehyde sources is not, by itself, a justification for reducing supply air quantities.

As becomes evident, selection of appropriate building materials is by far the better way to achieve good quality indoor air quality. Ventilation systems should not be relied upon to remove contaminants that could be avoided in the first place by proper control at the source.



SPIDER PLANTS and FORMALDEHYDE

A form of air purification which has received much attention is the use of house plants, especially spider plants (SOLPLAN REVIEW NO.3). The idea of botanical air purification is based on the research of B.C. Wolverton, a NASA scientist. His work demonstrated that spider plants can remove a considerable amount of formaldehyde from a onetime infusion of formaldehyde into a spider plant-occupied test chamber.

As a result of the publicity, many homeowners have employed spider plants to "purify" the air of their homes.

Despite the glamour of this technique, it is in fact not effective in reducing formaldehyde in an environment where it is continuously produced. In Wolverton's experiments formaldehyde was not continuously produced as is the case of residential environments where urea-formaldehyde resins are the dominant source.

In experiments at Ball State University spider plants consumed formaldehyde, but it was quickly replaced by the formaldehyde sources present in the test chamber itself. The small amount of formaldehyde control (up to 20%) that spider plants could achieve were offset by the increased emissions of formaldehyde caused by the increase in relative humidity associated by the presence of the plants themselves. The reason for this is that the off-gassing of formaldehyde goes on until it reaches an equilibrium balance that depends on moisture conditions and temperatures in the space.

The Ball State University researchers thus concluded that Spider plants are not effective in controlling formaldehyde in residential environments.

VENTILATION & BUILDER LIABILITY

In recent issues of SOLPLAN REVIEW we have expressed thoughts on the potential problems that may arise as a result of the way that the 1985 edition of the National Building Code has stated ventilation requirements.

The new Code simply states that

> *dwelling units shall have a mechanical ventilation system capable of providing at least one half an air change per hour during the heating season, based on the interior finished volume of the dwelling unit. The system shall be controlled either manually by a switch or automatically.*
>
> *Mechanical ventilation systems for dwelling units shall include provision for introduction of fresh make-up air from the exterior.*

The vague code language and the inexperience of most builders and building inspectors is going to lead to confusion and chaos. We have noted much confusion already in the Vancouver and Victoria area. Most inspectors are not yet certain how the new requirements should be satisfied. The only certainty is that a registered R-2000 house will exceed these requirements and hence will not require special consideration.

However, the builder not building an R-2000 house (i.e. many of the spec-built and low-bidder houses) is beginning to face some serious questions of how to comply with the new requirements.

Why be concerned? there are still many building science issues not fully understood about non-heat recovery ventilation systems, especially as they relate to homes with combustion appliances (fuel fired furnaces, fireplaces, wood stoves, ranges). In extreme cases, improperly built and vented houses can allow the creation of toxic conditions inside the house which can kill the occupants. As well, there are some potential conflicts with other standards (e.g. the gas code still does not require combustion air for gas fire places).

The builder must consider the implications of these changes on his liability, as ventilation systems that may meet the *letter of the code* could still create potential health risks for the occupants.

Are liability concerns an over-reaction? Something only lawyers are intereted in? We think not.

A Vancouver ventilation systems contractor, Soft Energy Systems, having received a number of enquiries for 'cheap' systems to meet code requirements became concerned enough to ask their lawyer about the legal liability issue of mechanical systems.

The legal opinion suggested that (if there is an action taken) "it is unlikely that an installer or manufacturer will be able to use the requirements of the National Building Code as a defence. This is because the code merely provides a minimum standard rather than requiring any specific type of equipment".

At the moment there is an action underway in Alaska. It was started by residents of an apartment building who are claiming damages resulting from respiratory illness caused by mechanical ventilation. In that case, the design had complied with the building code that was in force at the time of construction. After complaints from residents, they were forced by the State to comply with new code requirements (at a cost of 1 million dollars).

It may be difficult for residents to show a direct relationship between damages suffered and the mechanical ventilation system. But if the occupant can show that he or she has suffered health problems as a result of an inadequate or faulty mechanical ventilation system he will likely have an action against the builder (and ventilation system installer).

It must be recognized that for someone to be found liable in negligence, no contractual relationship is necessary - which is why several years after the house is built, a totally unrelated third party could, if conditions were present, sue the builder for negligence.

The moral of the story is that the 'cheap,quick and dirty' ventilation system should not be relied on to provide required ventilation. It means that a careful strategy must considered.

The cheap fans presently used so often should be thrown away and forgotten. There is going to a be a cost to a properly installed ventilation system. Either a few dollars are spent during the construction, or more are spent later - dealing with negligence claims brought on by unhappy occupants.

LETTER TO THE EDITOR

Sir,

The HRV industry has taken a lot of flak over the years and the continued publishing of inaccurate information doesn't help an industry that could use a little support instead of criticism.

Your table of HRV ratings is not correct. The values shown for efficiency at 0°C are not those used in the R-2000 Program. The R-2000 Program rates these units at 55 l/s (110 cfm).

For example, the Air Changer DRA 150: your rating of 82% is at 57 cfm (27 l/s). The HOT2000 rating is 76% at 55 l/s.

Other numbers that are wrong:

	SOLPLAN	R-2000
Air Changer DRA 150	82%	76
DRA 275	76	78
ThermAir 2000 RD	57	58
vanEE 2000/2D	62	64
2000/2DM	69	70

At -25°C:

Air-x-Change 502 CA	44	43
Air Changer DRA 275	50	56
Can Ray 2000Ex-H	49	50
Lifebreath 200 MAX	59	60
ThermAir 2000 RD	54	56

The differences may be small, but this industry deserves accuracy.

I am sure that I speak for the HRV industry when I ask you to print a correction in your next issue. My criticism is over accuracy not content.

Richard Olmstead
President, Conservation Energy Systems
Saskatoon, Sask.

This is not the only comment we received from the industry to our table. We appreciate your concerns over accuracy. It is our intention to be as exact as possible.

The table of HRV efficiency ratings was collated using consistent data from specification sheets prepared by the R-2000 Program based on Ontario Research Foundation testing.

Some confusion has been caused by the ***R-2000 calculated value*** *for HRV efficiency. The original* ***HOTCAN*** *computer program uses a single efficiency rating for the HRV. Based on earlier test results a table of values was published some two years ago (Solplan Review No. 7).*

The latest version of the computer program which has been in use for the past year (now called HOT-2000) calculates the amount of energy required to operate the HRV and a seasonal HRV efficiency for a specific location, hence the power consumption of the unit is also required in the inputs.

The R-2000 design evaluation guidelines require that power consumption and efficiency ratings be taken at 55 l/s air flow (or the next highest rating). However, the calculated efficiency ratings on the Specification sheets do not provide a corresponding power rating. It is for this reason that we did not use the calculated value, but took a consistent point.

Only two units could be corrected (the Air Changer DRA 150 and Can Ray 2000Ex-H). Both are smaller units and under most circumstances would seldom be designed for air flows in the 55 l/s range. This is why we also noted the ***net supply airflow (@75 Pa)*** *to give an idea of how much air the unit can supply in a typical installation.*

As we noted in the notes to the table, the efficiency of an HRV will depend on the total air flow; higher flows generally reduce, while lower air flows increase unit efficiency. In practice, for comfort, most HRV's are run at the lower air flows, so that when installed they should be more efficient than ratings.

The issue raised by the concern about the efficiency rating to the last percentage point reflects the competitive nature of the market that manufacturer's face, largely instigated by the weight given HRV efficiency by the R-2000 Program.

We are increasingly coming round to the belief that perhaps we shouldn't place so much concern to the last percentage point of the efficiency rating but rather to the overall performance characteristics: can the unit actually deliver required air flows? is it reliable? is it easily serviceable? priced competitively? reasonable after-sales service? The main benefit of the HRV, after all, is not so much the heat recovery, as the tempering of incoming ventilation air.

AEROCOWL **Flue Cap**

Research has shown that combustion appliances do not always properly exhaust the products of combustion. Flue backdrafting contributes to poor indoor air quality, and in extreme cases can lead to toxic concentrations of gases in the house.

A problem during stormy weather is the wind induced backdrafting of flues. Furnace and gas fireplace pilot lights can be blown out by gusts of wind that can travel down the flue. This can be very dangerous. Warren Jones, a Vancouver contractor, had problems with the gas pilot lights in fireplaces and the boiler being blown out by downdrafts in a recently completed West Vancouver home. To try and resolve the problem, he tried a new aerodynamically designed flue cap on one flue in the house and was surprised how well it performed.

The aerodynamically designed flue cap (which also acts as a rain cap) was developed in Ireland and can be used on gas, oil or solid fuel furnaces and boilers as well as all types of open fireplaces. it can be fitted to A or B vents, as well as masonry chimneys.

It has no moving parts, but three vanes and inverted aerofoil which maintain a constant pressure across the top of the flue, eliminating any chances of downdrafts. Because of the constant pressure on the flue fuels actually burn more efficiently and the energy efficiency of the appliance is improved. In wood burning appliances, the better flue performance also helps reduce creosote build-up.

The cap, called **Aerocowl** has been used successfully in numerous installations in the Winnipeg area, and has a CMHC acceptance number.

For information, contact:
Warren Jones
Cortez Energy Efficient Homes Ltd.
604-538-1754

PARALLAM PSL

HIGH TECH EXTRUDED LUMBER

First it was reconstituted milk, then potatoes and potato chips. Now the high tech age has come to the lumber industry, as McMillan Bloedel begins the large scale marketing of **Parallam**, a reconstituted extruded structural lumber, manufactured with microwave energy. **Parallam** is produced in continuous billets up to 60' or longer.

McMillan Bloedel has adapted the natural properties of lumber to fit the needs of the end user.

Parallam is a new, engineered structural product 15 years in development. It is targeted at the housing market for beam, header and column applications. It has already been used successfully in over 15,000 homes during the last two years of test marketing.

The unique blend of engineering and aesthetic appeal have been demonstrated in the mullions and braces of 151 modular units used for the 30 foreign pavilions at EXPO 86.

In over a decade of exhaustive testing, Parallam has been proven to be stronger and more resistant to the effects of long-term loading than conventional lumber. It is stiffer than standard lumber or glulam. The depth of headers and beams can be reduced without reducing their load carrying capacity.

SPAN	ALLOWABLE LOAD (pounds/lineal foot) (Maximum deflection L/360)			
	PARALLAM 1 3/4"x9 1/2"	FIR* (2x10)	PARALLAM 1 3/4"x11 1/2"	FIR* (2x12)
9'	454	223	768	284
10'	338	197	576	249
12'	201	159	346	200
14'	129	104	223	167
16'	87	70	152	125

* (Select Structural Douglas Fir)

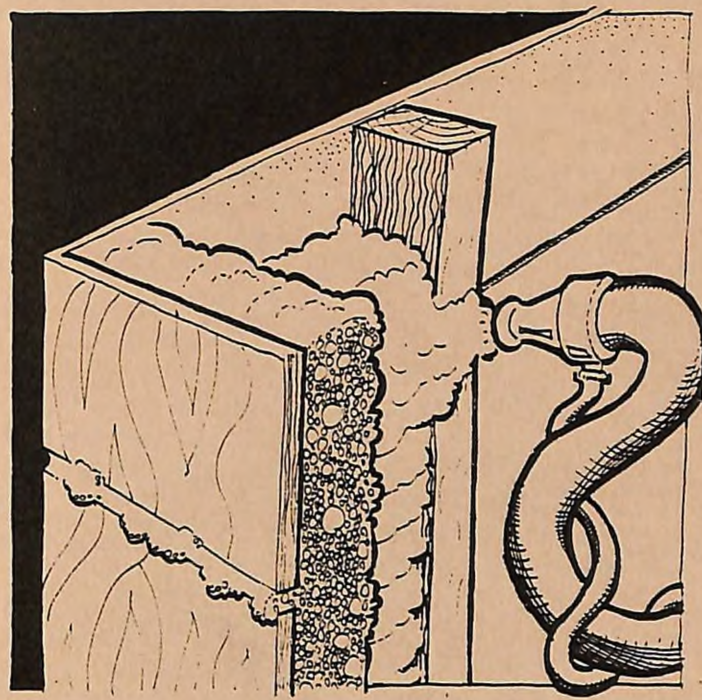
Because it is a manufactured product, factory quality control produces material that is straight, with a clean surface and defined dimensional tolerances. The moisture content of Parallam PSL (normally ten percent) is more stable than that of conventional lumber. It can be worked just like natural wood: cut, drilled, sawn or nailed with conventional tools.

The glue used is phenolformaldehyde (the same as used in exterior grade plywoods). It is a stable glue that once cured has few emissions.

Marketing is going to be through standard MacMillan Bloedel product distribution channels. Pricing is going to be "competitive with similar products" like microlams, but maybe a bit higher than gluelam.

Parallam beams and headers are available in two standard thicknesses: 1 3/4" and 3 1/2"; and in various depths up to 14".

Information:
Your local McMillan Bloedel building products dealer or
McMillan Bloedel Parallam Division
1272 Derwent Way, Annacis Island
Vancouver, B.C. V3M 5R1
Tel: 604-526-3624



INSEALATION

GOLD SEAL ICYNENE INSULATION

A new foamed in place insulation developed in Canada is being launched commercially by **Icynene Inc.** It is being marketed under the name of **Goldseal Icynene Air Seal Insulation** and **the Insealation system**.

The Insealation System combines the features of a semi-flexible microcellular plastic insulation, with a spray-in-place custom installation that must be applied only by qualified, certified applicators.

Icynene is a two component material made up of polyisocyanate, resins and catalysts. Carbon dioxide formed during the reaction is used as the blowing agent to create a finely celled, semi-flexible plastic foam. It has an aged **R value of 4.3 per inch** thickness.

The liquid product is sprayed directly onto the building surface using a spray-gun driven dual action pump. The foam sets up completely in seconds. A good air-seal is achieved by this on-site installation.

Gold Seal Icynene insulation is being marketed as an air-sealer and thermal insulation. The low density foam adheres to most substrates, and penetrates into building crevices. It has a low flame-spread rating and little detectable health hazard in service.

The distributors are heavily stressing the air sealing qualities. They have used

the product on one R-2000 house, but have not yet performed tests on just how tight a house can be sealed with the product. This is work that it to be done shortly. However, as with most spray in place foam insulations it should be the answer to most caulking and sealing problems, especially as the installation is done only by qualified applicators. Some locations will still have to be sealed and caulked (such as sill plates and around flues).

There is little specific information on cost, as it will depend on the characteristics of a specific installation. Judging by the stress the marketing people are placing on the air sealing properties as a justification for less insulation, one can only assume that the price will be at the top end of the scale. The stress on sealing is positive, as uncontrolled leakage is a major source of heat loss and moisture movement. But adequate R-values must still be provided.

The product has some limitations. The CMHC product evaluation report states that it is not for use:

- below grade outdoors or in contact with water.
- in a service environment with tempera tures above 82°C (180°F).
- above the roofing membrane.
- on the cold side of other insulation materials.
- inside electrical outlets or junction boxes.
- within 50mm of heat emitting devices.
- as an interior finish. The product should be protected on the interior surface by an interior finish that conforms to applicable building codes.

The product must be applied on surfaces whose temperatures cannot be less than 10°C or more than 30°C. This would mean that there could be problems with winter construction.

More information:
Icynene Inc.
376 Watline Rd.
Mississauga, Ont. L4Z 1X2

Tel: 416-890-7325

COMMENTARY: air testing of houses

The air test has been a unique and valuable part of the R-2000 Program as it is a performance evaluation of a house carried out by an independent contractor using standard procedures and specialized equipment.

Builders are anxious about the possibility of failing the air test because of cost and delays of a second test, extra cost for remedial work, potential contractual disputes with homeowners, and loss of respect from employees and customers.

As the envelope tightness is directly related to the key benefits of an R-2000 house, eliminating the air test is not a viable option.

The lack of availability of test services in some regions, concerns about cost, poor understanding and application of test procedures, and complexity of the test have prompted the R-2000 Program to look at alternatives. One alternative being promoted by CHBA is an alternative air test using simplified equipment assembled and built by the builder. But air tests for R-2000 houses must maintain a high degree of accuracy (in order to ensure repeatability and comparability of test results). Air testing should be done by well trained persons confident with their equipment. Air testing is emerging as a service industry that only partially relies on the air testing of the R-2000 houses as a source of income.

Builders have expressed concerns about accuracy of equipment used and procedures being followed. This is not surprising, as standards have not been enforced, and training programs or development of explanatory materials have not been supported by anyone else than equipment manufacturers.

A Canada wide Association is being formed to promote air test services and to establish levels of technical and professional expertise.

The major challenge is not to re-work test equipment procedures and equipment but to help ensure that every major urban centre has a competent and efficient air testing service for use by builders. Involving builders and other subtrades in the tests will reduce both the credibility of air tests and their value as a quality control measure. Promoting a do-it-yourself approach will also undermine the air testing contractor.

A more important issue to pursue is to encourage the growth of air-sealing subcontractors. These trades can guarantee that the house will pass the air test as long as the builder chooses certain types of windows and doors known to be manufactured for their tightness and installs a relatively airtight fireplace. (An air sealing sub-trade will open the door to large tract builders into the R-2000 program).

For more information on the Air Testers Association, contact:
Peter Moffat
Sheltair Scientific Ltd.
2 - 3661 West 4th Ave.
Vancouver, B.C. V6R 1P2

INSULATION COSTS

Insulation is a key element of energy efficient buildings. Much stress is placed on improving the R-value of a given component, so too often the tendency is to choose an insulation product for its R-value alone.

Yet the performance depends on not only on the R-value but also how well it is installed. Selecting an insulation product should be made not just on the R-value, but also its installed price, and quality of installation.

Batt and loose fill insulations are low cost but must be properly installed in order to obtain desired insulation levels. Improperly applied they will not provide the desired R-value. For example, an R-20 batt installed in a 2x6 wall may end up providing an overall R14-16 (or less) if the insulation is not installed properly.

How to compare prices? Insulation materials have differing properties, so it is hard to compare prices directly. The best indicator is a **price per R value**.

We researched the cost of commonly used insulation products in several major Canadian cities. The prices were obtained by random sampling, and may vary between suppliers based on mark-ups, quantity discounts, availability, taxes. They give an idea of prices across the country, and how products compare with each other.

We also looked for prices of loose fill insulation, but these are generally supplied through insulation contractors on an installed basis. However, we were able to determine the following approximate prices (per 35/40 lb. bag):

	Glass-fiber	Cellulose	Mineral wool
Toronto	$ 18.90	9.80	
Edmonton	18.20	8.50	
Vancouver	19.70		9.04

The table lists prices: per square foot of insulation, and R value per square foot.

		TORONTO		WINNIPEG		EDMONTON		VANCOUVER	
INSULATION TYPE	R	$/SQ.FT.	¢/SQ.FT.	$/SQ.FT.	¢/SQ.FT.	$/SQ.FT.	¢/SQ.FT.	$/SQ.FT.	¢/SQ.FT.
FIBREGLASS	20	.41	2.050	.348	1.740	.38	1.900	.407	2.035
GLASSCLAD (1 2/2")	6.7	.55	8.209	.524	7.821	.53	7.910	.56	8.358
BASECLAD (2")	8.5	.7	8.235	.614	7.224	.640	7.529	.690	8.118
POLYSTYRENE (1 1/2")	7.5	.655	8.733	.618	8.240	.570	7.600	.621	8.280
POLYSTYRENE (1 1/2") (beadboard)	5.6	.304	5.429	.271	4.839	.300	5.357	.326	5.821
POLYISOCYANURATE (Thermax - 1")	5.56	.825	14.838		.000	.500	8.993	.638	11.475